DOCUMENT RESUME

ED 156 433 SE 024 305

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TITLE Measurement Module: The International (SI) Metric System.
SPONS AGENCY Murray State Univ., Ky.; Office of Education (DHEW), Washington, D.C.
PUB DATE 78
CONTRACT 561-AH-70073
NOTE 59p.; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Activity Units; Bibliographies; *Guidelines; History; *Instruction; Interdisciplinary Approach; Mathematics Education; Measurement; *Metric System; *Teacher Education; Teaching Methods

ABSTRACT

This module was prepared to "metricate" approximately 3800 teachers in Western Kentucky. A brief history of measurement systems is followed by sections concerning length, mass (weight), temperature, and area and volume measurement. Each section contains a list of the common metric units used and their relationship as well as activities for learning to think with metric measures. A pretest and posttest are included. The appendices contain treatments of the metric system rules and units; metric units for everyday use; recommendations, ideas, and teaching suggestions for developing metric programs and introducing the metric system; and a bibliography of metric publications along with a list of metric materials available at no cost to teachers as well as available inexpensive metric publications. (MN)

Measurement Module

The International (SI) Metric System

Murray, Kentucky

MEASUREMENT MODULE

The International (SI) Metric System

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Sponsored by DHEW/OE Contract No. 561AH70073
and Murray State University

ACKNOWLEDGEMENTS

This module was compiled as a result of many people and resources. A large portion of the activities in this module were adapted from a booklet called "Introduction to the Metric System". This booklet was originally published by the Manitoba Department of Education in 1973, revised and reprinted by the Metric Commission, Ottawa, Ontario, 1974.

Also, we wish to acknowledge the assistance of the American Institutes for Research Metric Education Technical Support Program (sponsored by the U.S. Office of Education).

As is usually the case, there is someone who has to do all of the hard work in preparing the final copy. In this venture we wish to acknowledge and thank

BENITA GREER of Murray, Kentucky.

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"It is therefore declared that the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States and to establish a United States Metric Board. . ."
(Metric Conversion Act of 1975)

Someday you will awaken to your alarm clock and on its face will be the numbers 6:30. You will go into your kitchen and have a spoonful of lo cal sugar with your coffee along with one egg from your dozen egg carton, a slice of toast, a pat of butter, and a little milk. You will probably read the cereal box with all that nice little information about nutrition and suddenly realize that for the first time in your whole life you really understand what those numbers mean. So you look at your carton of milk or your stick of butter (margarine) and discover that milk prices and butter prices are not as ridiculous as it seems because (lo and behold!) there is really more milk in that carton and there's really more butter (margarine) in that stick. ("Somehow," you'll say, "It really didn't look like more.")

You will all of a sudden break out in a big laugh at all those arguments that you've seen lately. That grocery scene over apparent inflated prices. That department store scene about the outrageous 38's and 43's in dresses and skirts that really fitted the "same" as one garment after the other was tried on. The realization that when you said "fill 'er up" you paid exactly the same as you always did and when you said "$5.00 worth" it took you as far as $5.00 worth ever did. And to top it all off you argued with your "in-laws" just last month about how unfortunate this whole metric mess is.

Go on and have a good laugh. You have worked hard for it and you deserve it.

What are some of the arguments for and against the metric (SI) system? Below is a scrambled list of the basis for some arguments. See whether you can identify the advantages or disadvantages of the changeover to metrics. Compare your answer with those at the bottom of this page.

____A. A universal system that will stimulate sales and improve balance of exports with imports.

____B. Not everything is metric.

____C. Expense.

____D. Reluctance to change.

____E. Easier to use decimal system.

____F. Calculations are faster.

____G. Less chance of error.

____H. Re-education.

____I. Interchange of machine parts.

____J. Standard tools

____K. Transition will take time

____L. Time saving.

____M. Interrelationship of units

____N. Opportunity for manufacturers to standardize sizing of goods and materials.

A. a B. d C. d D. a E. a F. a H. d I. a J. a

K. d L. a M. a N. a

Pretest: Think Metric!

Directions: Circle the letter of the most correct answer.

1. A gram is about the weight of:
   a. an apple
   b. a paper clip
   c. a pineapple

2. A metre is about the height of:
   a. a door
   b. a kitchen counter
   c. a chair seat

3. Water freezes and boils at:
   a. 32°C and 212°C
   b. 100°C and 200°C
   c. 0°C and 100°C

4. A measuring cup would hold:
   a. 2 millilitres
   b. 20 millilitres
   c. 250 millilitres

5. A newborn baby weighs about:
   a. 3 kilograms
   b. 30 kilograms
   c. 300 kilograms

6. A male basketball player is about:
   a. 20 centimetres high
   b. 200 centimetres high
   c. 2000 centimetres high

7. Normal body temperature if about:
   a. 25°C
   b. 37°C
   c. 45°C

8. A can of soda holds about:
   a. 1.5 litres
   b. 1 litre
   c. 0.4 litres

9. A litre of water weighs about:
   a. 100 grams
   b. 10 grams
   c. 1000 grams

10. A new lead pencil is about:
    a. 50 millimetres long
    b. 100 millimetres long
    c. 200 millimetres long

11. One teaspoonful of maple syrup would be about:
    a. 0.5 millilitres
    b. 1 millilitre
    c. 5 millilitres

12. An average man weighs about:
    a. 45 kilograms
    b. 80 kilograms
    c. 180 kilograms

13. A dollar bill is about:
    a. 15 centimetres x 7 centimetres
    b. 20 centimetres x 10 centimetres
    c. 100 centimetres x 70 centimetres

14. The thickness of a dime would be about:
    a. 0.1 millimetres
    b. 1 millimetre
    c. 5 millimetres

Answers to pretest:

1. b 2. b 3. c 4. c 5. a 6. b 7. b 8. c 9. c 10. c 11. c 12. b 13. a 14. b

UNITED STATES DEPARTMENT OF COMMERCE
ROGERS C. B. MORTON, Secretary
NATIONAL BUREAU OF STANDARDS / ERNEST AMBLER, Acting Director

Special Publication 304A Revised August 1975

Brief History of

MEASUREMENT SYSTEMS

with a Chart of the Modernized Metric System

"Weights and measures may be ranked among the necessaries of life to every individual of human society. They enter into the economical arrangements and daily concerns of every family. They are necessary to every occupation of human industry; to the distribution and security of every species of property; to every transaction of trade and commerce; to the labors of the husbandman; to the ingenuity of the artificer; to the studies of the philosopher; to the researches of the antiquarian; to the navigation of the mariner, and the marches of the soldier; to all the exchanges of peace, and all the operations of war. The knowledge of them, as in established use, is among the first elements of education, and is often learned by those who learn nothing else, not even to read and write. This knowledge is riveted in the memory by the habitual application of it to the employments of men throughout life."

JOHN QUINCY ADAMS
Report to the Congress, 1821

Weights and measures were among the earliest tools invented by man. Primitive societies needed rudimentary measures for many tasks: constructing dwellings of an appropriate size and shape, fashioning clothing, or bartering food or raw materials.

Man understandably turned first to parts of his body and his natural surroundings for measuring instruments. Early Babylonian and Egyptian records and the Bible indicate that length was first measured with the forearm, hand, or finger and that time was measured by the periods of the sun, moon, and other heavenly bodies. When it was necessary to compare the capacities of containers such as gourds or clay or metal vessels, they were filled with plant seeds which were then counted to measure the volumes. When means for weighing were invented, seeds and stones served as standards. For instance, the "carat," still used as a unit for gems, was derived from the carob seed.

As societies evolved, weights and measures became more complex. The invention of numbering systems and the science of mathematics made it possible to create whole systems of weights and measures suited to trade and commerce, land division, taxation, or scientific research. For these more sophisticated uses it was necessary not only to weigh and measure more complex things—it was also necessary to do it accurately time after time and in different places. However, with limited international exchange of goods and communication of ideas, it is not surprising that different systems for the same purpose developed and became established in different parts of the world—even in different parts of a single continent.

The English System

The measurement system commonly used in the United States today is nearly the same as that brought by the colonists from England. These measures had their origins in a variety of cultures—Babylonian, Egyptian, Roman, Anglo-Saxon, and Norman French. The ancient "digit," "palm," "span," and "cubit" units evolved into the "inch," "foot," and "yard" through a complicated transformation not yet fully understood.

Roman contributions include the use of the number 12 as a base (our foot is divided into 12 inches) and words from which we derive many of our present weights and measures names. For example, the 12 divisions of the Roman "pes," or foot, were called *unciae*. Our words "inch" and "ounce" are both derived from that Latin word.

The "yard" as a measure of length can be traced back to the early Saxon kings. They wore a sash or girdle around the waist—that could be removed and used as a convenient measuring device. Thus the word "yard" comes from the Saxon word "gird" meaning the circumference of a person's waist.

Standardization of the various units and their combinations into a loosely related system of weights and measures sometimes occurred in fascinating ways. Tradition holds that King Henry I decreed that the yard should be the distance from the tip of his nose to the end of his thumb. The length of a furlong (or furrow long) was established by early Tudor rulers as 220 yards. This led Queen Elizabeth I to declare, in the 16th century, that henceforth the traditional Roman mile of 5,000 feet would be replaced by one of 5,280 feet, making the mile exactly 8 furlongs and providing a convenient relationship between two previously ill-related measures.

Thus, through royal edicts, England by the 18th century had achieved a greater degree of standardization than the continental countries. The English units were well suited to commerce and trade because they had been developed and refined to meet commercial needs. Through colonization and dominance of world commerce during the

and 19th centuries the English system of weights and measures was spread to and established in many parts of the world, including the American colonies.

However, standards still differed to an extent undesirable for commerce among the 13 colonies. The need for greater uniformity led to clauses in the Articles of Confederation (ratified by the original colonies in 1781) and the Constitution of the United States (ratified in 1790) giving power to the Congress to fix uniform standards for weights and measures. Today, standards supplied to all the States by the National Bureau of Standards assure uniformity throughout the country.

The Metric System

The need for a single worldwide coordinated measurement system was recognized over 300 years ago. Gabriel Mouton, vicar of St. Paul in Lyons, proposed in 1670 a comprehensive decimal measurement system based on the length of one minute of arc of a great circle of the earth. In 1671 Jean Picard, a French astronomer, proposed the length of a pendulum beating seconds as the unit of length. (Such a pendulum would be fairly easily reproducible, [illegible] the widespread distribution [illegible] standards.) Other proposals were made, but over a century [illegible] action was taken.

[illegible] in the midst of the French [illegible] the National Assembly of [illegible] the French Academy [illegible] an invariable [illegible] all the measures and all the [illegible]. The Commission appointed by [illegible] a system that was [illegible] simple and scientific. The unit [illegible] was to be a portion of the earth's circumference. Measures for capacity (volume) and mass (weight) were to be derived from the unit of length, thus relating the basic units of the system to each other and to nature. Furthermore, the larger and smaller versions of each unit were to be created by multiplying or dividing the basic units by 10 and its powers. This feature provided a great convenience to users of the system, by eliminating the need for such calculations as dividing by 16 (to convert ounces to pounds) or by 12 (to convert inches to feet). Similar calculations in the metric system could be performed simply by shifting the decimal point. Thus the metric system is a "base 10" or "decimal" system.

The Commission assigned the name *metre* — which we spell meter — to the unit of length. This name was derived from the Greek word *metron*, meaning "a measure." The physical standard representing the meter was to be constructed so that it would equal one ten-millionth of the distance from the north pole to the equator along the meridian of the earth running near Dunkirk in France and Barcelona in Spain.

The metric unit of mass, called the gram, was defined as the mass of one cubic centimeter (a cube that is 1/100 of a meter on each side) of water at its temperature of maximum density. The cubic decimeter (a cube 1/10 of a meter on each side) was chosen as the unit of fluid capacity. This measure was given the name liter.

Although the metric system was not accepted with enthusiasm at first, adoption by other nations occurred steadily after France made its use compulsory in 1840. The standardized character and decimal features of the metric system made it well suited to scientific and engineering work. Consequently, it is not surprising that the rapid spread of the system coincided with an age of rapid technological development. In the United States, by Act of Congress in 1866, it was made "lawful throughout the United States of America to employ the weights and measures of the metric system in all contracts, dealings or court proceedings."

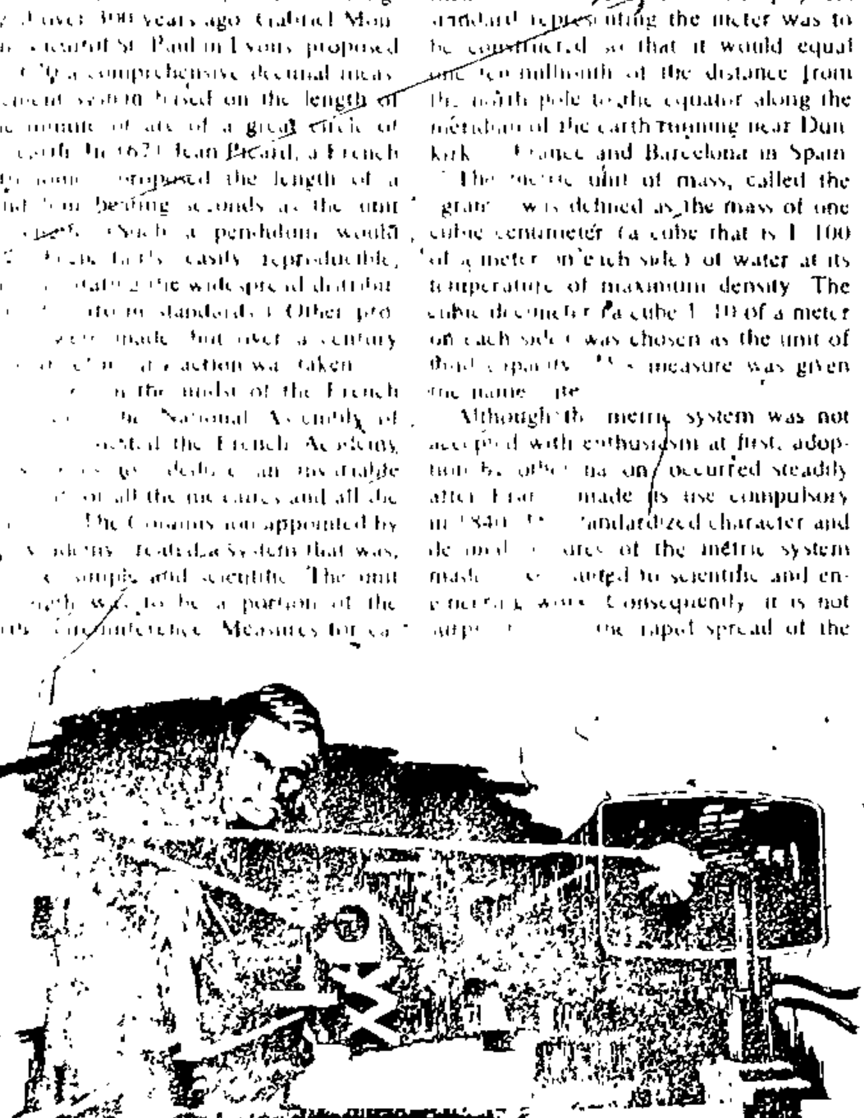
By the late 1860's, even better metric standards were needed to keep pace with scientific advances. In 1875, an international treaty, the "Treaty of the Meter," set up well-defined metric standards for length and mass, and established permanent machinery to recommend and adopt further refinements in the metric system. This treaty, known as the Metric Convention, was signed by 17 countries, including the United States.

As a result of the Treaty, metric standards were constructed and distributed to each nation that ratified the Convention. Since 1893, the internationally agreed-to metric standards have served as the fundamental weights and measures standards of the United States.

By 1900 a total of 35 nations, including the major nations of continental Europe and most of South America, had officially accepted the metric system. Today, with the exception of the United States and a few small countries, the entire world is using predominantly the metric system or is committed to such use. In 1971 the Secretary of Commerce, in transmitting to Congress the results of a 3-year study authorized by the Metric Study Act of 1968, recommended that the U.S. change to predominant use of the metric system through a coordinated national program. The Congress is now considering this recommendation.

The International Bureau of Weights and Measures located at Sevres, France, serves as a permanent secretariat for the Meter Convention, coordinating the exchange of information about the use and refinement of the metric system. As measurement science develops more precise and easily reproducible ways of defining the measurement units, the General Conference on Weights and Measures, the diplomatic organization made up of adherents to the Convention, meets periodically to ratify improvements in the system and the standards.

In 1960 the General Conference adopted an extensive revision and simplification of the system. The name *Le Système International d'Unités* (International System of Units), with the international abbreviation SI, was adopted for this modernized metric system. Further improvements in and additions to SI were made by the General Conference in 1964, 1968, 1971 and [illegible]



LENGTH MEASUREMENT

This section includes the measurement for length, width, height, thickness, and distance.

COMMON METRIC UNITS USED FOR LENGTH MEASUREMENT:

millimetre (mm)	Used in measuring very small lengths. Example -postage stamp.
centimetre (cm)	Used in measuring very common lengths. Example -body measurements.
metre (m)	Used in measuring intermediate lengths. Examples -room size, track and field events.
kilometre (km)	Used in measuring long distances. Example -from one town to another.

RELATIONSHIP OF THE METRIC UNITS USED FOR LENGTH MEASUREMENT:

kilometre
hectometre
dekametre
metre
decimetre
centimetre
millimetre

10 millimetres = 1 centimetre
100 centimetres = 1 metre
1000 metres = 1 kilometre

Note: Shaded terms are not commonly used.

Activities for learning to think with length measures:

Needed Materials: 30 centimetre ruler; 150 cm measuring tape trundlewheel; metre stick; millimetre micrometer or caliper.

Body measures have always been used as primary references for approximating the length of objects. Historical units have been so names, i.e.,

Palm - of your hand.

Span - tip of your thumb to the tip of your little finger.

Cubit - tip of your elbow to the tip of your second finger.

Fathom - tip of second finger on left hand to tip of second finger on right hand when arms are extended.

Foot - you guessed it, King What's-it's foot.

Yard - derived from gird (around the waist).

Mile - from mille (meaning thousand) passos (steps) the number of steps the Roman soldier walked in a day.

Inch - from uncia, relating to a part of the human foot.

As you can see, body references are key to measurement.
Your Turn!

1. Go over to the wall (in class or not) and locate a point to represent your height. First estimate how tall you are using the historical units listed below on the left and then give an actual measurement using that unit:

Unit	Your Estimate	Actual Measurement
Palm	_____	_____
Span	_____	_____
Cubit	_____	_____
Fathom	_____	_____
Inch (uncia)	_____	_____

Let's face it! Despite the fact that the Metric System (Le Systeme International d'Unite's) is a very logical system and is not based on body measures but on the wavelength of Superman's Krypton 86 orange-red light, most of us will still need some ready references to make comparisons of length. So let's not waste any time and METRICATE OUR BODS. (Warning: Because of the sensitive nature of portions of this

activity, interpersonal discretion is advised.)

You need a Metric Tape Measure or Metre Stick. Fill in your measurements below as applicable:

Body Measurements

A Man — Height _____ centimetres

Waist _____ cm

Neck _____ cm

Hip (seat) _____ cm

Sleeve _____ cm

Head _____ cm

A Woman — Height _____ cm

Bust _____ cm

Hip _____ cm

Waist _____ cm

Back Waist Length _____ cm

A Small Child — Height _____ cm

Chest _____ cm

Waist _____ cm

Foot _____ cm

USE A TRUNDLE WHEEL! Measure some length with the wheel. What did you measure and how long was it? _____

_____

Now it's time to go crazy. Measure your finger, your thumb, your lips, your finger nail, your foot, your car, your friend, . . .oops! That's all there is to it.

Oh, no! It looks like somebody has really flipped their lid. Don't they know they have to click that trundle wheel 40 000 kilometres all the way around the world: Bon Voyage!

More activities to help you Think Metric with length.

1. Draw a freehand line of the specified lengths by estimation. Then check your measurement with a ruler.

10 mm

100 mm
1 cm
10 cm
0.01 m
0.1 m

2. Measure this line ⊢——⊣ and express in:

millimetres _____ mm

centimetres _____ cm

metres _____ m

3. Measure the length of this line and express in:

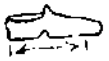
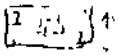
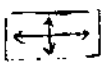
⊢————————————————⊣

millimetres _____ mm

centimetres _____ cm

metres _____ m

4. ESTIMATE each of the following before doing the actual measurement. Express the answers as indicated in each activity.

	Estimate	Actual
a. your handspan 	_____ cm	_____ cm
b. lenght of your shoe 	_____ cm	_____ cm
c. length of a dollar 	_____ cm	_____ cm
d. width of a dollar 	_____ cm	_____ cm
e. length of your pen or pencil 	_____ cm	_____ cm
f. length of your stride 	_____ cm	_____ cm
g. your chair height 	_____ cm	_____ cm
h. height of a door 	_____ cm	_____ cm
i. length or width of this room 	_____ cm	_____ cm
j. thickness of a quarter 	_____ cm	_____ cm
k. diameter of a quarter 	_____ cm	_____ cm
l. thickness of a dime	_____ cm	_____ cm

FOR THE MATHEMATICALLY INCLINED:

Remember when you had to make conversions from inches to yards or from feet to miles?

It went like this:

How many inches in 11 1/2 yards?

Solution: $\frac{36 \text{ inches}}{1 \text{ yard}} \times 11\ 1/2 \text{ yards} = 414 \text{ inches.}$

or How many inches in 1 mile 250 feet?

$\frac{12 \text{ inches}}{1 \text{ foot}} \times \frac{5280 \text{ feet}}{1 \text{ mile}} + 250 \text{ feet} = ?$

or Change 75 inches to yards.

$\frac{36 \text{ inches}}{} \times \frac{? \text{ yards}}{75 \text{ inches}} = ??$

IN METRIC (Get out your calculators!)

Change 712 centimetres to metres.

(Presto!
Decimal Pointo!
Completo!) → Solution 7.12 m

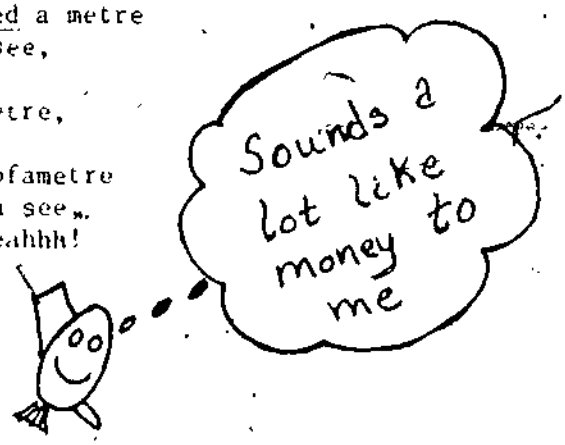
TAKE A CLOSER LOOK!

km	hm	dam	m	dm	cm.	mm
			7	1	2	

Don't throw the calculator away just yet!

It's time for a song!

The metre is the unit for length
Stretch it by ten and you get a tenametre
Oh, that's english for dekametre.
Stretch it by a hundred and you get a hundred a metre
---That's english for hectometre, you see,
Hmm. . .a. . .ooo. . .ahh. . .laaa. . . .
Shrink the metre by ten and it's a tenthofametre,
Oh, that's english for decimetre.
Shrink it by a hundred and it's a hundredthofametre
---That's english for a centimetre, you see.
Hmm. . .a -- ooo -- ahh. . .laaah. . .oh, yeahhh!



Did you notice earlier that if you move that ol' decimal point to the right of the place value you were converting to, that was all you had to do?

Try your hand at conversions!

	Change	To
1.	7.12 m	_____ cm
2.	7.12 dm	_____ m
3.	712 dam	_____ m
4.	712 m	_____ km

Think!

km	hm	dam	m	dm	cm	mm
			7	.1	2	
				7	.1	2
7	1	2.				
7	1	2.				

Answers:
1. 712 cm
2. 712 m
3. 7120 m
4. 0.712 km

Do it Right!

1. Leave a space between the number and the symbol.

   7.12 m and not 7.12m

2. Never write a measurement starting with a decimal point.

   0.712 m and not .712 m

MASS (WEIGHT) MEASUREMENT

This section includes the measurement of quantity of matter or the measurement of mass. Mass, which remains the same anywhere in the universe, is measured in units of milligrams, grams, kilograms, and tonnes.

In everyday life, mass and weight are often used interchangebly. But mass is the amount of matter an object contains, and it never changes. Weight is the force on an object due to gravity acting on the mass of the object. This weight may change, as in outer space where objects are "weightless".

COMMON METRIC UNITS USED FOR MASS MEASUREMENT:

milligram (mg)	Used in measuring extremely small amounts of mass. Examples - pharmaceuticals, vitamins , compounds.
gram (g)	Used in measuring small amounts of mass. Examples - box of breakfast cereals, butter.
kilogram (kg)	Used in measuring larger amounts of mass. Examples - bag of potatoes, apples.
tonne (t)	Used in measuring very large amounts of mass. Examples - coal, iron ore, wheat shipments.

Relationship of the metric units for mass measurement:

megagram - tonne
kilogram
hectogram
dekagram
gram
decigram
centigram
milligram

Note: Shaded terms are not commonly used.

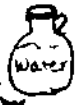
Conversion from one unit to another is done as for the metre -- moving the decimak appropriately

Activities to enable you to Think Metric with Mass Measurements:

Needed materials:

- metric bathroom scales
- balance scale and weights
- plastic measuring cups (in ml)
- plastic square litre containers
- wheat or rice
- dried beans
- potatoes
- salt
- oranges or apples
- large book.

In each of the following activities, ESTIMATE first and then find the actual mass measurement. Express the answers as indicated.

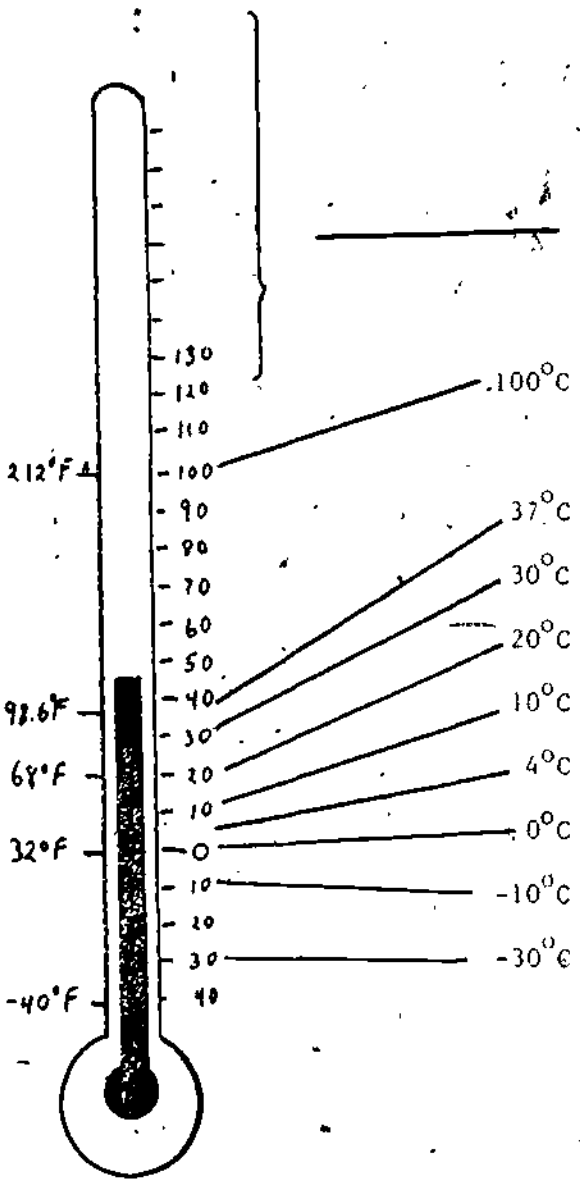
	Estimate	Actual
a. this booklet 	_____g	_____g
b. one container of beans 	_____kg	_____kg
c. one container of rice (or wheat) 	_____kg	_____kg
d. one litre of water 	_____kg	_____kg
e. potatoes (bag) 	_____kg	_____kg
f. yourself 	_____kg	_____kg
g. an orange 	_____g	_____g
h. a 250 ml cup of salt 	_____g	_____g
i. a large book 	_____kg	_____kg

TEMPERATURE MEASUREMENT

This section includes the measurement of temperature in the metric system by using the Celsius thermometer scale. The Celsius thermometer was named after Anders Celsius (1701-1744), an astronomer and scientist from Uppsala, Sweden, who first presented the idea of separating the freezing point and boiling point of water with 100 equal parts. Hence:

the freezing point of water is $0^{\circ}C$
the boiling point of water is $100^{\circ}C$.

Relationship of Celsius and Fahrenheit Scales:



Oven cooking temperatures

	°C	°F
Near Broil	260-290	500-550
Very Hot	230-245	450-475
Hot	200-220	400-425
Moderate	175-190	350-375
Slow	150-165	300-325
Very Slow	120-135	250-275

$100^{\circ}C$ - boiling point of water

$37^{\circ}C$ - normal body temperature

$30^{\circ}C$ - beautiful summer day for swimming in Kentucky.

$20^{\circ}C$ - normal room temperature

$10^{\circ}C$ - beautiful spring day (hopefully)

$4^{\circ}C$ - water at maximum density

$0^{\circ}C$ - freezing point of water

$-10^{\circ}C$ - cold day in Kentucky

$-30^{\circ}C$ - very cold day in Kentucky

Activities to help you Think Metric with Temperature Measurement:

Materials Needed: thermometer

1. Indicate the Celsius temperature for each of the following:

   a. water freezing _____ ^{o}C

   b. water boiling _____ ^{o}C

   c. present room temperature _____ ^{o}C

   d. normal body temperature _____ ^{o}C

   e. approximate outside temperature _____ ^{o}C

   f. comfortable outdoor swimming temperature _____ ^{o}C

   g. warmest outdoor temperature you have experienced _____ ^{o}C

Note: The Celsius scale is derived from the Kelvin scale. The term 'Kelvin' is derived from Baron Kelvin of Largs. He lived between 1824 and 1907 and began work in thermodynamics very early in life. He attended Glasgow University at the age of 11 where he proposed the second law of thermodynamics.

AREA AND VOLUME MEASUREMENT

AREA is defined as the amount of surface space.

VOLUME is defined as the amount of three-dimensional space occupied by a quantity of matter.

Common Metric Units used in Area and Volume Measurement:

AREA uses length measurements and is expressed in:		Example of use:
square kilometre	(mm^2)	-large bodies of water or land.
square hectometre	**(hm^2)**	-10 000 m^2 or 1 hectometre is called 1 hectare and is a common land measurement.
square dekametre	**(dam^2)**	
square metre	(m^2)	-fabric, commercial lots, large amount of sheet metal, floor area.
square decimetre	**(dm^2)**	
square centimetre	(cm^2)	-area of cartons, pans
square millimetre	(mm^2)	

VOLUME uses length measurements and is expressed in:		Example of use:
cubic kilometre	(km^3)	-ocean capacity
cubic hectometre	**(hm^3)**	
cubic dekametre	**(dam^3)**	
cubic metre	(m^3)	-sand, coal, grainbins, natural gas, water, lumber.
cubic decimetre	**(dm^3)**	
cubic centimetre	(cm^3)	
cubic millimetre	(mm^3)	

Note: Shaded terms are not commonly used.

Activities to help you to Think Metric with Area and Volume Measurements:

Needed Materials: 30 centimetre ruler
150 cm measuring tape
boxes

1. Find the area of the following. ESTIMATE before the actual measurement:

	Estimate	Actual
a. the cover of this booklet	_____ cm^2	_____ cm^2
b. the floor of this room	_____ m^2	_____ m^2

2. Find the volume of the following. ESTIMATE before the actual measurement:

	Estimate	Actual
a. plastic decimetre cube	_____ cm^3	_____ cm^3
b. this room to the height of 2 m.	_____ m^3	_____ m^3

CAPACITY MEASUREMENT

COMMON METRIC UNITS OF CAPACITY MEASUREMENT:

millilitre (ml)	Used in measuring small amounts of liquids. Examples -- medication, soft drinks (1 ml = 1 cm^3)
litre (ℓ)	Used in measuring common amounts of liquids. Examples - milk, gasoline paint. (1ℓ = 1000 cm^3)

Relationship of metric units in capacity measurement:

megalitre
kilolitre
hectolitre
dekalitre
litre
decilitre
centilitre
millilitre

Note: Shaded terms are not commonly used.

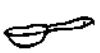
Conversion from one unit to another is done as for the metre and gram--moving the decimal appropriately.

Activities to enable you to Think Metric with Capacity Measurement:

Needed materials:

- metric graduated containers
- plastic funnels
- plastic measuring tablespoons
- measuring cups (250 ml)
- non-graduated containers
- pitcher
- drinking cups
- soda can
- large soda bottle
- graduated syringes
- measuring teaspoons.

In each of the following activities, first ESTIMATE and then find the actual capacity. Express the answers as indicated in each activity.

		ESTIMATE	ACTUAL
a. pitcher		_____ ℓ	_____ ℓ
b. one cup		_____ ml	_____ ml
c. tablespoon		_____ ml	_____ ml
d. teaspoon		_____ ml	_____ ml
e. soda can		_____ ml	_____ ml
f. large soda bottle		_____ ml	_____ ml

Post test: Think Metric

Directions: Circle the letter of the item that is most nearly correct.

1. Two kilograms is about the weight of:
   a. a bag of sugar
   b. an apple
   c. a silver dollar

2. A metre is about the height of:
   a. a kitchen counter
   b. the average man
   c. a chair seat

3. Water freezes at:
   a. 37°C
   b. 32°C
   c. 0°C

4. Instead of "1 cup", a recipe will probable read:
   a. 250 ml
   b. 20 ℓ
   c. 200 mm

5. A newborn baby should weigh about:
   a. 12 kg
   b. 3 kg
   c. 8 kg

6. The average woman is about how tall?
   a. 200 cm
   b. 105 cm
   c. 160 cm

7. When the temperature of 10°C outdoors, it would be appropriate to wear:
   a. insulated clothing
   b. light coat
   c. "street clothes" (no sweater)

8. Milk will probably be sold in what units?
   a. millimetres
   b. litres
   c. millilitres

9. A litre of water weighs about:
   a. a kilogram
   b. 100 grams
   c. 5000 grams

10. The width of your palm is approximately:
    a. 1 metre
    b. 1 centimetre
    c. 10 centimetres

11. A teaspoon of water is about:
    a. 5 ml
    b. 5 mg
    c. 5 mm

12. The average woman weighs about:
    a. 115 kg
    b. 55 kg
    c. 80 kg

13. The page this is written on measures about:
    a. 95 cm x 33 cm
    b. 120 cm x 80 cm
    c. 28 cm x 22 cm

14. The thickness of a dime is about:
    a. 0.5 mm
    b. 3 mm
    c. 1 mm

Answers: Post test

1. a 2. a 3. c 4. a 5. b 6. c 7. b 8. b 9. a 10. c 11. a 12. b 13. c 14. c

APPENDIX A: THE METRIC SYSTEM

THE METRIC SCALE

kilo	metre (km) litre (kl) gram (kg)	=	1000	(10^3)	metres litres grams
hecto	metre (hm) litre (hl) gram (hg)	=	100	(10^2)	metres litres grams
deka	metre (dam) litre (dal) gram (dag)	=	10	(10^1)	metres litres grams
METRE LITER GRAM	(m) (l) (g)	=	1	(10^0)	metre litre gram
deci	metre (dm) litre (dl) gram (dg)	=	0.1	(10^{-1})	metre litre gram
centi	metre (cm) litre (cl) gram (cg)	=	0.01	(10^{-2})	metre litre gram
milli	metre (mm) litre (ml) gram (mg)	=	0.001	(10^{-3})	metre litre gram

PREFIXES -- SI

Prefix	Symbol	Multiples and Submultiples	
exa	E	1 000 000 000 000 000 000 (10^{18})	one quintillion
peta	P	1 000 000 000 000 000 (10^{15})	one quadrillion
tera	T	1 000 000 000 000 (10^{12})	one trillion
giga	G	1 000 000 000 (10^{9})	one billion
mega	M	1 000 000 (10^{6})	one million
kilo	k	1 000 (10^{3})	one thousand
hecto	h	100 (10^{2})	one hundred
deka	da	10 (10^{1})	ten
deci	d	0.1 (10^{-1})	one tenth
centi	c	0.01 (10^{-2})	one hundredth
milli	m	0.001 (10^{-3})	one thousandth
micro	μ	0.000 001 (10^{-6})	one millionth
nano	n	0.000 000 001 (10^{-9})	one billionth
pico	p	0.000 000 000 001 (10^{-12})	one trillionth
femto	f	0.000 000 000 000 001 (10^{-15})	one quadrillionth
atto	a	0.000 000 000 000 000 001 (10^{-18})	one quintillionth

METRIC SYSTEM (SI) RULES

1. Avoid capitalization of unit names (except Celsius) unless they start a sentence.

   Example:
   metre not Metre
   kilogram not Kilogram

   Note: Unit names are not capitalized even though some of their symbols are, with the exception of degree Celsius.

2. Pluralization of symbols is not to be used.

   Example:
   3 mm not 3 mms
   6 g not 6 gs

3. Never use a prefix without a unit either in writing or speech.

   Example:
   kilometre or kilogram not kilo
   millimetre or milligram not milli

4. Use a zero before the decimal point when the numerical unit is a partial unit.

   Example:
   0.401 mm not .401 mm
   0.5 g not .5g

5. Do not use periods with symbols except at the end of a sentence.

   Example:
   m not m.
   cm not cm.

6. When dividing, the use of an oblique stroke (/) is preferred, to separate the numerator and denominator.

   Example:
   metre per second squared-m/s^2
   kilogram per cubic metre-kg/m^3
   kilometres per hour-km/h

7. Prefixes in denominators are to be avoided, except with the kilometre. (Express denominators in terms of base unit, not multiples of it.)

   Example:
   MN/m^2, not N/mm^2

8. Commas are not to be used as place markers when writing large numbers. Instead use a space. The reason for this is that many countries using the metric system use the comma as we use the decimal point.

   Example:
   367 245.261 3, not 367,245.2613

9. Always leave a space between digits and symbols.

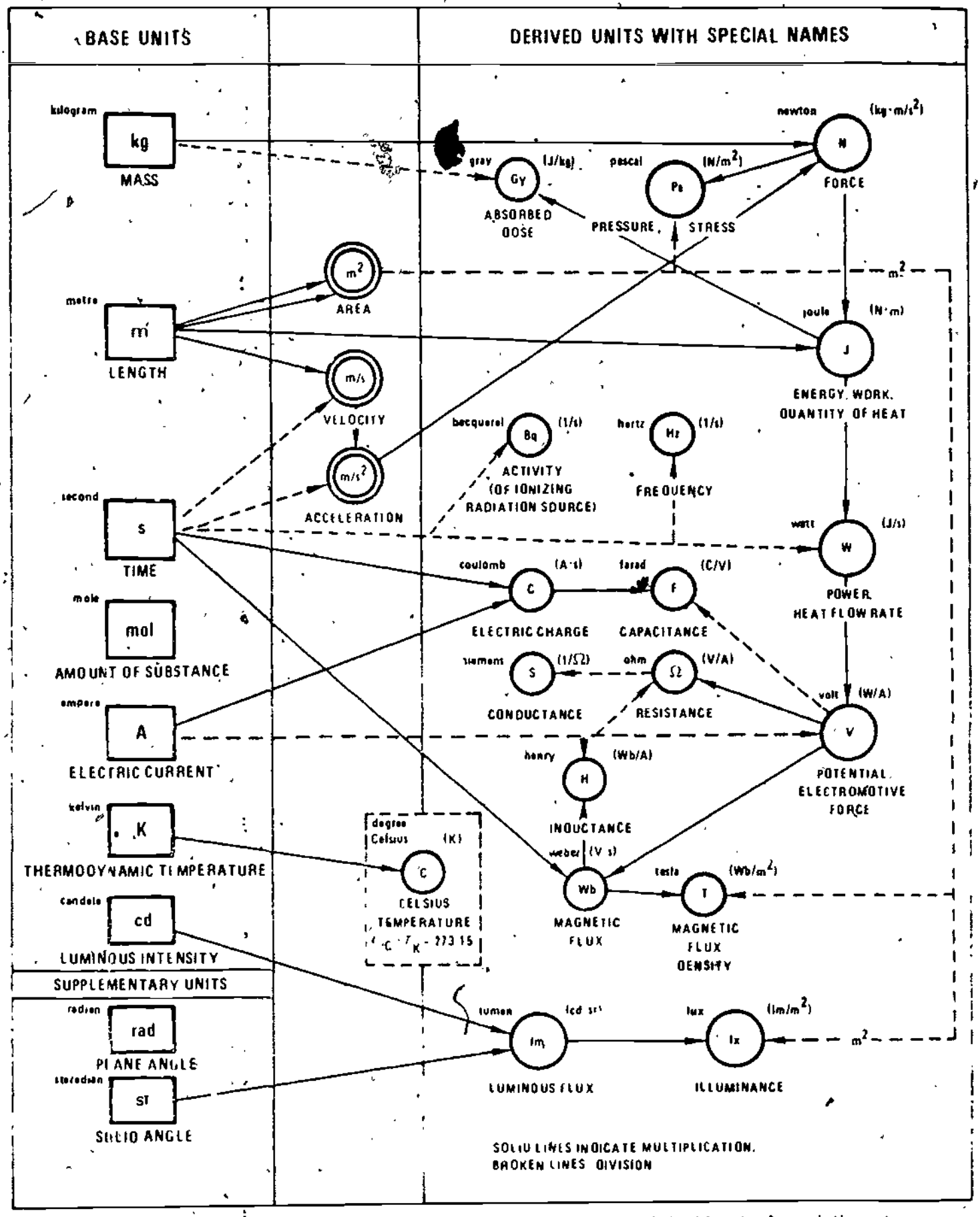
   Example:
   67 m not 67m
   0.123 cm^3 not 0.123cm^3

10. Prefixes that are powers of 10^3 (micro, milli, kilo) are preferred. Others should be avoided where convenient.

11. Avoid mixing multiples of units.

   Example:
   15.75 m not 15 m 750 mm

THE INTERNATIONAL SYSTEM OF UNITS (SI)



U.S. Metric Association, Inc

APPENDIX B: METRICS FOR EVERYDAY USE

The average person in non technical roles will use only a small portion of the entire metric (SI) system as they only use a small portion of the customary system.

For Length:	Kilometre (km); metre (m); centimetre (cm); and millimetre (mm).
Area:	Square metres (m^2); square centimetre (cm^2).
Volume:	Cubic metre (m^3); cubic centimetre (cm^3).
Capacity:	Litre (ℓ); millilitre (ml).
Mass:	Kilogram (kg); gram (g). ton or tonne (t)
Temperature:	Degrees Celsius (^oC).

Listed are some occupations that may use measurement. See if you can tell what metric measures each will use.

army recruit
baker
bus driver
boxer
carpenter
carpet salesperson
child care aide
cook
customer
doctor
electric meter reader
farmer
firefighter
grocer
hardware store clerk
heating, ventilating, and air conditioning service person
nurse
nursery worker
painter
paper hanger
parent
pilot
plumber
police officer
post office clerk
sales clerk
shoe clerk
tailor
taxi driver
truck driver
veterinarian
wall paper hanger

APPENDIX C:

CURRICULA MATERIALS

AND

TEACHING SUGGESTIONS

METS

METRIC EDUCATION TECHNICAL SUPPORT PROGRAM
American Institutes for Research
P O Box 1113, Palo Alto, CA 94302

METS INFORMATION BULLETIN

RECOMMENDATIONS FROM INTERSTATE CONSORTIUM ON METRIC EDUCATION*

The Interstate Consortium on Metric Education (ICME) was conceived out of the need for a set of uniform guidelines and principles, to be used in developing quality metric education programs. Sponsored by the U.S. Office of Education, the Interstate Consortium on Metric Education was organized and coordinated by the Mathematics Task Force of the California State Department of Education. Two major meetings were held in 1974.

The representatives attending the meetings came from 28 states and territories with centralized textbook adoption policies and were those persons who had the primary responsibilities for developing metric programs for the schools in their states. In addition to the 28 state representatives, official observers attended from three other states. The 23 final ICME recommendations can be categorized as follows:

Recommendations 1-11	Development and evaluation of instructional materials and pedagogy
Recommendations 12-18	Implementation of the changeover to metrics and promotion of public support
Recommendations 19-23	Preservice and inservice teacher-training programs in measurement

Because of the importance of the ICME project, we feel that its final report should be available to those responsible for planning metric education. Since it is no longer available from the California State Department of Education, the American Institutes for Research has summarized the 23 recommendations for your consideration. Because considerable variation exists among state-level education agencies, the ICME Report recognizes that some modifications may be necessary to meet the conditions unique to a particular state or territory.

THE ICME RECOMMENDS:

1. that the International System of Units (SI) be the standard units of measurement used in all instructional programs.

   Rationale: The policy of viewing the International System of Units as the dominant system of measurement was enacted by the U.S. Congress on August 21, 1974.

* Excerpted from *Interstate Consortium on Metric Education: Final Report*. California State Department of Education: Sacramento, 1975.

The complete document is available from the Educational Resources Information Center (ERIC) for $1.67 plus $.25 postage. Send check or money order to: EDRS, P.O. Box 190, Arlington, Virginia 22210, asking for ED 103-282, Paper Copy (HC)

2. for matters concerning definition of units, style and spelling, the NBS publication, 330, and the ASTM publication, E 380-72 be used in the preparation of instructional materials.

Rationale: NBS 330 is an approved English translation of the report entitled "[illegible]", which was originally issued by the International Bureau of Weights and Measures. The ICME also reviewed "[illegible]" (E 380-72) of the American Society for Testing and Materials (ASTM), and found it acceptable for the purposes. The latest revision is E 380-76, "[illegible]".

Although there has been no national consensus on the spelling of the base unit of length, the ICME prefers the spelling m-e-t-r-e and l-i-t-r-e. It also suggests that the word *weight* and its derivatives (*weigh, weighing,* etc.) be avoided in instructional programs. Units of mass (kilogram) should be used whenever mass is intended; units of force (newton) should be used whenever force is intended.

3. that during the period of transition, provision be made for the inclusion of metric materials commensurate with the achievement and maturity of the students. The scope should be sufficiently broad and sequenced in a manner to facilitate student development to a level of performance normally expected at appropriate maturity levels.

Rationale: It is essential that the material developed be at the appropriate maturity level so as to elicit the proper student response and to enable an orderly transition to metrics.

4. that instructional materials reflect a genuine concern for how and when children learn to measure by following an appropriate sequence: (a) comparison between objects; (b) comparing non-standard units with objects; (c) comparing objects to be measured with SI units; (d) choosing measurement units of appropriate size for specific tasks.

5. that activity-oriented measurement experiences for children be planned to include the following learning processes: language development, estimation and verification, simple matching and comparison, ordering, simple relations and mapping, and pictorial representations.

6. that all prefixes in the range m .lli- to kilo- be presented to illustrate the logical structure of the metric system. However, commonly used units should be emphasized in learning activities and applications and are in underlined below.

millimetre	millilitre	milligram
centimetre	centilitre	centigram
decimetre	decilitre	decigram
metre	litre	gram
dekametre	dekalitre	dekagram
hectometre	hectolitre	hectogram
kilometre	kilolitre	kilogram

Two commonly used terms which do not incorporate commonly used prefixes are "cubic decimetre" (dm^3) and "hectare" (ha). The cubic decimetre should be used to show the relationship between linear measure and volume; the square kilometre and/or the hectare are used as the units for large land areas.

Rationale: The majority of SI units are intended for use in specialized areas of endeavor and will not be of direct concern to the general public. The "commonly used" units listed in Recommendation 6 are those that all persons should know and/or be able to use efficiently. Square kilometres should be used when square miles are applicable; hectares should be used when acres are applicable.

7. that the recording of measurements within SI be expressed in decimal notation.

8. that the conversion process between SI and other systems of units should be avoided. In disciplines where conversion is presently relevant and required, appropriate information should be available that does not require the use of conversion formulas.

Rationale: Conversions within the metric system should be taught, with emphasis on the learner's understanding of the base-ten nature of the metric system.

9. that in the pronunciation of metric prefixes, the accent be placed on the first syllable.

10. that efforts be made to ensure that metrication be realized through integration of SI throughout the entire school curriculum and that the metric system not be presented as an isolated topic of study.

Rationale: It is the intent of this recommendation that metrics *not* be identified as a special subject.

11. that evaluative criteria for the adoption of instructional materials include the pertinent recommendations of this Consortium.

Rationale: As it relates to measurement, the evaluation criteria should have a common core. Additional criteria, such as cost or format, may be included according to local needs.

12. that metric awareness for the public and intensive inservice programs for school personnel precede adoption of metric educational materials.

Rationale: Past experience indicates the necessity of providing information to the public, prior to introducing new programs in the classroom.

13. that state educational agencies encourage teacher education institutions to begin immediately to include opportunities for students to develop competencies in using and teaching the metric system.

Rationale: Teacher-education institutions should include the study of the metric system in their programs.

14. by January 1, 1978 that states include in their evaluative criteria for adoption of instructional materials the pertinent recommendations of this report.

15. that during the adoption cycle of the transition period, state education agencies encourage local education agencies to provide instructional materials for supplementing textbooks which have little or no metric measurement content.

16. that January 1, 1980 be the target date for the completion of the transition to the metric system in textbooks and other instructional materials; ICME recognizes that certain vocational/technical timelines may be bound to related industrial conversion.

17. coordinated state efforts be made to inform and involve business, industry, and other organizations in the transition to metric SI. A broad, multi-faceted public-awareness program should be undertaken and should include but not be limited to: state agency, teacher association, and other professional publications; professional meetings; TV programs and public service announcements; encouragement of libraries and instructional material centers to obtain metric related materials; establishment of communication channels to provide information about the metric system and assistance to local education agencies in implementing public relations programs; the encouragement of and assistance to local education agencies in efforts to inform and involve parents in the transition to the metric system.

18. state education agencies encourage formative evaluation to determine proper placement for metric measurement activities.

19. that preservice and/or inservice education programs be designed to prepare elementary teachers, administrators, and support personnel involved in instruction to implement measurement using metric units. The recommended program includes two areas of concern: (a) Metric awareness, (b) Metric measurement experiences for teachers and aides.

Rationale: The following components should be incorporated in metric awareness programs: (1) History; (2) Advantages of the SI metric system; (3) Resistance to changing to SI metrics; (4) Introduction to SI metric units.

Experiences with metric measurement for elementary level teachers and aides should include the following: (1) Activities similiar to those in which students will be involved; (2) Informal and formal diagnostic techniques; (3) Introduction to SI metric prefixes, symbols, and notation terminology; (4) Use of community resources; (5) Examination of learning materials for measurement.

20. that preservice and/or inservice training programs for secondary teachers (grades seven through twelve) be designed to help these teachers become aware of the basic content and learning principles used in the elementary metric programs. In addition, secondary training programs should contain more

concentrated, in-depth treatment of measurement for teachers in specialized areas. These specialized areas are: (1) vocational/technical education, including industrial arts, home economics and related fields; (2) mathematics and science.

21. that state education agencies provide leadership by developing a core of resource personnel whose responsibility will be to implement metric education programs at the local level.

22. that measurement inservice programs for individuals directly involved in teaching measurement to students be of 10-16 hours. Introductory inservice programs of 3-6 hours on metric measurement should be designed for all individuals involved in instruction. In both programs "hands on" activities should be emphasized.

23. that: (A) Mathematics and Science teachers assume the major responsibility for teaching the metric system; (B) Teachers in all subject areas assume the responsibility for teaching applications of the metric system.

Rationale: Teaching the metric system is a multidisciplinary concern.

Produced under Grant #C007604212 from the U.S. Office of Education, DHEW

METS

METRIC EDUCATION TECHNICAL SUPPORT PROGRAM
American Institutes for Research
P O Box 1113. Palo Alto. CA 94302

METS INFORMATION BULLETIN

IDEAS FOR INTRODUCING THE METRIC SYSTEM

Our changeover to metrics will not only affect us in math and science, but will influence us whenever measurement is used. The following ideas for teaching metric measurement are oriented towards secondary teachers desiring to teach the metric system in courses other than mathematics or science. They were adapted from a booklet prepared by LeRoy Negus, Chairman, Department Metric Committee, Bureau of General Education Curriculum Development, The State Education Department, Albany, New York 12234. According to Mr. Negus, some of the ideas were taken from materials developed by David Dye, Mathematics Consultant, State of Minnesota and Susanne Reeder, Mathematics Supervisor, City of Buffalo. We hope that this bulletin will be useful to you in approaching metric education as an interdisciplinary subject.

Agriculture Education

(1) Have students discuss the ramifications of the change to the metric system for farmers and agri-business.

(2) Have students look for present uses of the metric system on the farm and in the home.

(3) Investigate the unit of land area called the hectare. Compare this with acres.

Art Education

(1) Devise graphics which can be used to enlighten and educate the public about the metric system.

(2) Cooperate with other departments in preparing posters for a "Think Metric" campaign.

Business Education

(1) Discuss how businesses and offices will be affected with the change to the metric system. Will office personnel need to know the system well? Explain.

(2) Secretaries, typists, and office machine operators will have to know the correct abbreviations, paper dimensions, and new scales used on typewriters and other office machines.

(3) Bookkeepers and other record keepers will have to become familiar with terminology and relationships of the metric values to perform various types of office computation, record keeping, and billing.

Driver Education

(1) Plan a trip using a state road map, and translate distances into kilometres.

(2) Discuss kilometres per litre as an alternate to miles per gallon..

(3) Drive over a measured kilometre and compare with a mile.

(4) Convert present speed limits to metric. What problems will arise when we change to metric? Discuss.

English Language Arts

(1) Have students prepare an advertising campaign to convince people to use the metric system.

(2) Ask students to select ads from magazines and newspapers. Convert the information in the ads to the metric system.

(3) Using Poe's "The Gold Bug," have the students convert the directions to the metric system.

(4) Have the students write a short story in which metric measurement plays an important role.

Foreign Languages

(1) Discuss and compare the measurement system of the country(ies) whose language(s) is being studied.

(2) Learn the derivation of the base units and prefixes. Show similarities of nomenclature in all languages.

(3) Have students create posters and bulletin board displays featuring the metric system with all terminology and numbers in the target language.

(4) Through a unit featuring the preparation of a foreign food specialty, use metric measurements for ingredients (dry and liquid) and for baking or cooking temperatures.

(5) Discuss the climate and weather in the target language areas using degrees Celsius for temperatures, in various seasons, millimetres for average precipitation, and kilometres per hour for wind velocity.

(6) Using the international notation of square metres to determine the amount of living space in a dwelling, measure your home and compare with the average space of a dwelling in the country of the target language. (If applicable, measure your property and compare with corresponding property in the target language country. For example, farms, suburban housing, apartments, etc.)

Health Education

(1) Measure the height and weight of students using the metric system.

(2) Use metric measures when studying units on nutrition.

(3) Using the metric system, construct a graphic presentation to demonstrate the degree to which the earth's atmosphere has already been altered, and will be altered within the next 10 years. Relate the amount of gas released to the extent to which the atmosphere is changed, and resulting increases in the incidence of health problems (e.g., cancer of the skin).

(4) Have students investigate what sources of water are used for the requirements of industry, and of homes, in their community. Have them calculate how much water, in litres, is used by each per day, from each source, and for what purpose. Students might record how much water they personally use in a 24-hour period.

(5) Make a chart showing the comparative volumes of safe and unsafe water available for use in the United States, and in another country, such as India. Show figures regarding water available per person in each country. Express findings in litres.

(6) Utilize the metric system when discussing the pharmacological aspects of drugs, alcohol, and tobacco.

(7) Utilize the metric system when discussing causes and prevention of accidents (first aid and safety course).

(8) The metric system should be used for nearly every health topic in regards to the incidence of disease, epidemiologic studies, surveys, and the like.

Homemaking - Family Living

(1) Plan a project for a group of students to help them "Think Metric."

(2) Develop a bulletin board or display on the effect of the metric system on the home.

(3) Write a recipe using metric measures. There will be changes in measurements of ingredients, pan sizes, and oven temperatures.

(4) Use metric recipes when cooking; include some recipes from foreign cookbooks.

(5) Determine your chest, waist, hip, and height measurements in metric.

(6) Use a pattern with metric measurements for constructing a garment.

(7) Figure the area of a floor metrically. How many 30 centimetre tiles are needed to cover the floor of your classroom?

(8) Compute fabric requirements for draperies, slip covers, and articles of clothing in metric amounts.

(9) Research how clothing is sized in some of the countries already involved in metric measurements.

(10) Investigate point-of-sale aids and guides that would help consumers make informed choices when metric units become predominant in stores.

(11) Conduct a supermarket survey to find out: what products have labels in metric units, dual-labeled, or unlabeled and what value metric labeling is to the average consumer at this time.

(12) Investigate and report on the status of legislation for metric conversion and what stands consumer groups are taking on such legislation.

(13) Organize and prepare a meal using only metric measures.

Industrial Arts

(1) Discuss with the students the implications of a changeover to the metric system as applied to their particular vocations.

(2) Design an article with metric dimensions and make it using metric measures.

Library Media

(1) Find information on the metric system. Where did you look first? What did you find? Where did you look second? What did you find?

(2) Find evidence of the use of metric measurement in our country at the present time. Verify this by talking to druggists, doctors, camera salesmen, etc.

(3) Develop a bibliography of multimedia resources available in the library.

(4) Develop multimedia resource kits for various grade levels and/or focusing on various subject areas.

(5) Have high school students develop multimedia presentations on various aspects of metrication for presentation to elementary pupils.

(6) Develop reference and research skills lessons based on metrication themes or activities suggested for the various subject areas.

(7) Create a floor plan of the library media center using metric measure.

(8) Create displays, exhibits, and bulletin boards publicizing available resources.

Music

(1) Discuss the statement: Music is a universal language and, as such, transcends any changes within the various languages or systems of weights and measures.

(2) Cooperate with other departments, particularly math, social studies, and language arts in discovering songs about the metric system which might be sung, and encourage children to create and perform their own songs which relate to concepts about the metric system.

Physical Education

(1) Discuss measurement changes to the metric system in such things as tennis, golf, and other sports. Some students may want to find our how playing fields, courts, etc. are laid out in metric countries.

(2) Discuss how sports records may be changed when we adopt the metric system.

(3) Hold a track meet and use the metric system for identifying distances, heights, and weights.

(4) Discuss the effects of a measurement change to the metric system in sports supplies and equipment; i.e., length of baseball bat; circumference of baseball, basketball, volleyball, etc.; weight of shot put, discus, weight lifting equipment; length of skis!!

Social Studies

(1) Discuss: Why should we change to the metric system? Give five advantages, five disadvantages.

(2) Predict attitudes toward change to the metric system as related to age. Survey to check the prediction.

(3) Develop a list of countries not now committed to the metric system. What does this finding imply to us? What about countries that we trade with?

(4) Identify occupations now using the metric system. Find out why they use the system.

(5) Identify those occupations which will have to undergo the most change when converting to metrics.

(6) Interview parents on how the metric system will affect them.

(7) Plan a trip using the metric system. (gasoline, distance, rate, etc.)

(8) Think of some ways that unethical businessmen can use the metric system in dishonest transactions.

(9) Think of some ways that ethical businessmen can use the metric system to benefit the public.

(10) Write a letter to your Congressman suggesting ways to ease the problems of change.

(11) Discuss how a common measurement system would contribute to better world communication and understanding.

Produced under Grant #C007604212 from the U.S. Office of Education, DHEW

TEACHING SUGGESTIONS

Measurement is the process of making comparisons.

- To measure length you compare something that has length with something else that has length.
- To measure area you compare something that has area with something else that has area.
- To measure volume or capacity you compare something that has volume or capacity with something that has volume.
- To measure weight or mass you compare something that has weight or mass with something that has weight or mass.

Etc.

Of course, this is an oversimplification of the many facets of measuring objects or events, anyway we hope you get the idea.

Consider when teaching children:

1. A vast majority of number experiences are really measurement experiences. (Children often have to answer the questions "how many?", "how much?" "How much more?" etc.) A good teacher will enhance the learning process by using measurement terminology wherever applicable.
2. Measurements of continuous objects are always approximation.
3. Units used are quite arbitrary and have not been decreed by the heavens. Therefore, allow your students to discover the mechanisms for measurement.
   a. As much as possible, allow your students to estimate (make a guess) before actual measurements are made.
   b. Allow your students to actually make measurements rather than manipulate numbers and symbols. Give them opportunity to measure

MEASURING TOOLS TO HAVE AVAILABLE:

Length -

string	unmarked rulers and metre sticks
paper clips	rubber bands
pencils	tape measures
trundle wheel	
and anything that has _____;	

Area -

rulers and metre sticks, etc.
washers
chips
square objects
trundle wheel
rectangles
triangular objects
graph paper
or anything that has _____.

Volume and Capacity -

empty cans
graduated cylinders (measuring cups)
shoe boxes
blocks
metre sticks and rulers
anything that has _____.

Mass -

play doh, plasticene, etc.
blocks
weights
fruit
or anything that has _____.
shoes
pan balances
spring scales
platform scales

Temperature -

containers for warm and cold solutions
thermometers

Money -

play money
newspaper ads
catalogs
commercial games

Time -

clock with hour hand only
clock with minute hand, etc
hour glass
sundials
stopwatch

Angles -

protractors

MAKE YOUR OWN METRIC MEASURING AIDS*

Here is a list of measuring aids you can make yourself. If you need greater detail, please contact the authors of this module.

Length and Area

Metre Tape	from adding machine tape, ribbon, oil cloth strips, or chair webbing.
Ten centimetre Ruler	from popsicle stick.
Ten metre Rope	from tying knots in rope or marking off segments with tape.
Metric Slide Caliper	out of tagboard or cardboard.
Metric Depth Gauge	out of particle board and plastic mirror holders.
Map Measurer	from pizza cutter.
Trundle Wheel	from an empty thread spool.
Micrometer	from a nut and bolt.
Litre Set	from milk cartons.
Displacement Bucket	from milk cartons.
Pan Balances	from pegboards; wooden stick and fishing nail; milk cartons, clothespins, ruler, and paper clips; empty can, ruler, clothespins, and wire; coat hanger; etc.
Spring Scale	using rubber bands; using a spring.
Mass Pieces	from empty cans or sacks and objects such as rocks.

1 sugar cube = 2 grams; 1 nickel = 5 grams; 1 kilogram = full 16 oz. bottle of soda; 2 dozen medium eggs in carton.

*Edited from Make Your Own Metric Measuring Aids, Compiled by: Susan G. Hanson; Graphics by Anatta Blackmarr; Assisted by Don Reed and Leonard Lutomski of American Institutes for Research Metric Education Technical Support Program under Grant #G 00760 4212 from the U.S. Office of Education.

The National Bureau of Standards has published a bibliography that was prepared by the National Council for Teachers of Mathematics in 1975. The NBS printed this along with other helpful information in a publication called "2 to Get Set". The bibliography is reproduced here. However, an updated and more complete listing is available from the NCTM.

FOR THE STUDENTS' SHELF

The letter code after the annotation denotes the following classifications

P Primary *J Junior High*
I Intermediate *S Senior High*
A Adult

Print

Branley, Franklyn *Think Metric* New York Crowell, 1972 $4 50

Colorful book in narrative style, with historical and descriptive data about metric and English systems of measurement Large print for reading ease I/J

DeSimone, D V *A Metric America A Decision Whose Time Has Come* National Bureau of Standards, 1971 $2 25 (SD Catalog No C13 10 345)

Illustrated report to the Congress from the Department of Commerce, history, practices, trends, recommendations and information on metrication in other countries I/S/A

Donovan, Frank *Let's Go Metric* New York Weybright and Talley, 1974 $5 95

Advantages of the metric system, history of measurement and summary of SI J/S/A

Hirsch, S Carl *Meter Means Measure The Story of the Metric System* New York Viking, 1973 $4 95

Discusses reasons for going metric through historical "tales" on the development of measurement and the metric system I/S/A

Ross, Frank, Jr *The Metric System Measures for All Mankind* ill by Robert Galster New York Lippincott Phillips, 1974 $8 95

Traces the origin and development of the metric system to the present SI, includes tables, conversion charts and glossary J/S/A

For the Student's Shelf (print)

Rothrock, B D *The Consumer An Interim Report of the U S Metric Study* National Bureau of Standards, Special Publication 345-7 1971 $1 25 (SD Catalog No C 13 10 345-7)

Report to the Congress by the Department of Commerce based upon a study of consumer attitudes and issues J/S/A

Treat, Charles F *A History of the Metric System Controversy in the United States* National Bureau of Standards Special Publication 345-10 1971 $2 25 (SD Catalog No C13 10 345-10)

Account of the metric system controversy based upon extensive survey of historical data J/S/A

Vickers, J S *Making the Most of Metrication* New York Beekman, 1969 $10 95

Graphic discussion of the early years of Great Britain's national changeover effort S/A

Willert, Fritz *My Metric Measurement Manual* Two Rivers, Wis Pauper Press, 1974 $1 00

80-page booklet in cartoon story format introduces the metric system to children P/I

Non-Print

The Adventures of Mr Windbag in Metricland 3 filmstrips with cassettes, color, teacher's guide, student sound sheets Oak Brook, Ill Educational Products, 1974 w/student sound sheets, $75 00, w/o student sound sheets, $45 00

Individual or group program for learning metric length, volume, weight, worksheets and individual sound recordings included P

Decimeter Athens, Ohio Lawhead Press, 1974 $11 00

Game to strengthen or extend knowledge of metric units and prefixes, includes metric questions I/J

Discover Why Metric 8mm, color, 16 mm, color S Beloit, Ill Regal Beloit, 1972 $115/$195

Basic principles of the metric system in cartoon format, illustrated by chief character, "Metric Mike" I/J/S/A

International System of Units 16mm, color Seattle, Wash King Screen, 1970 $250 00

Measuring methodology for length, mass, time and temperature for physical science students

Introducing the Metric System 4 filmstrips, 2 records color Santa Monica, Calif BFA Educational Media, 1973 $48 00

Metric units, relationships and uses in measuring length, volume, mass Activity cards included I/J

Learning About Metric Measures 16mm color Santa Monica, Calif BFA Educational Media, 1970 $215 Introduces basic concepts emphasizes decimal nature of metric system P/I/J

Measurement 2 filmstrips, color, teacher's guide Chicago, Ill Visual Education $7 00

Discusses history of measurement, length in the metric system, and the outlook for a metric future I/S

Measuring A Metric Approach Multimedia kits Tarrytown, New York Schloat Unit I (Length and Area) $160, Unit II (Volume and Weight) $215, both $355 00

Multimedia kit includes filmstrips and manipulative materials to introduce the metric system as a "first language" of measurement I/J

Measuring the Metric Way 2 filmstrips with discs or cassettes, color New York Guidance Associates, 1974 w/disc $22 w/cassette $24 50

Shows the use of meters, centimeters, kilometers, grams, kilograms and liters, teacher's guide P/I

Meter Liter and Gram 16mm color Santa Monica, Calif BFA Educational Media, 1970 $170

Initial experiences with metric length, capacity, weight Discussion aids included J/S/A

Meters, Liters and Kilograms 16mm color Northfield, Ill. Metrication Institute of America, 1974 $310 Also available as three separate films *The Meter* $150, *The Liter* $90 *The Kilogram*, $150

Introduces metric measurement through a variety of activities performed by children P/I

A Metric [illegible] 16mm color Hollywood Calif AIMS 1973 $215 8mm also available

Animated narration showing the need for transition to metric and its effect J/S A

The Metric Center Kit Palo Alto, Calif Enrich, 1974 $55

Instruments and other materials in a kit with activities questions and a device for individual response and feedback I/I

Metric Ladder Race Oviedo, Fla Kent Educational 1974 $7 95

Game for learning metric prefixes and their meanings I/I

Metric System for the Intermediate Grades Set I, 4 filmstrips with discs or cassettes color Set II 4 filmstrips with discs or cassettes, color New Rochelle New York Pathescope, 1973 Set I (Length Area Volume) w discs $52 w/cassettes $60 Set II (Capacity Mass Metric Relationships) w discs $39 w cassettes $45

Simplified introduction to the basic metric units and relationships I/I

The Metric System The Universal Language of Measurement revised 6 filmstrips with cassettes color New Rochelle New York Pathescope 1974 $75

Introduces metric length area volume mass and capacity discusses metric units in the science laboratory I/S

Metric System Teaching Tapes 6 cassettes and workbook New York Houghton Mifflin, 1973 $36

Introduces basics of metric measurement for everyday use I/J

The Metrication of America 4 filmstrips with discs or cassettes, automatic and manual, color New York Westinghouse, 1974 $69 50

Sequential series Cartoon characters show how metric system affects life I/J/A

FOR THE REFERENCE SHELF

Print

Hopkins, Robert A *The International Metric System and How It Works* Tarzana, Calif Polymetric, 1973 $12 95

History and present status of the metric system, benefits and costs, NBS information on SI units many tables and conversion factors

Page, Chester H and Vigourerex, Paul (eds) *The International System of Units (SI)* National Bureau of Standards, Special Publication 330 1974 $0 65 (SD Catalog No C13 10 330/3)

English version of the international resolutions from 1889 to 1971, including the agreements defining "Le Systeme International d'Unites" -- the SI

Metric Editorial Guide Washington, D C American National Metric Council, 1974 $1.50

Guide to the proper writing and usage of metric terms -- the internationally agreed on units and their symbols, with suggested American practice for using and punctuating them

Metric System Guide Library 5 v Neenah, Wis J J Keller, 1974 $395 set, $99 ea vol

I Metrication in the United States, Orientation and Structure, II Legislation and Regulatory Controls, III Metric Units Edition, IV Reference Sources, V Metric Definitions

NBS Guidelines for Use of the Metric System National Bureau of Standards, LC 1056 1974

Brief, but authoritative outline of the SI measurement language terms, symbols, prefixes how to write and use them

Some References on Metric Information With Charts on All You Need to Know About Metric [and] Metric Conversion Factors National Bureau of Standards Special Publication 389 1973 $0 35 (SD Catalog No C13 10 389)

List of publishers and location of specific metric materials includes books, films kits posters other instructional materials

FOR THE PROFESSIONAL SHELF

Print

Adams, Herbert F. R. *SI Metric Units: An Introduction* New York: McGraw-Hill, 1974. $3.95 pap.

Brief history, explanations of units, problems, solutions, and conversion tables.

Ambruster, F. O. *Think Metric: A Basic Guide to the Metric System* San Francisco: Troubadour Press, 1974. $1.50.

Lighthearted introduction to SI, with cut-outs and activities.

Cherrington, Don. *Metric Workshop for Teachers, Book 6* Stockton, Calif.: Willow House, 1974. $2.50.

Detailed practicum-type activities for metric planning, teaching, and evaluation.

An Educator's Guide to Teaching Metrication Chicago: Sears Roebuck, 1974. Free upon request to Sears Consumer Information Services.

History, objectives, inter-disciplinary activities, and projects.

Glaser, Anton. *Seater by the Meter: An American Guide to the Metric System* Southampton, Pa.: A. Glaser, 1974. $6.50, $3.50 pap.

Compendium of information useful to teachers and parents.

Henderson, George L. and Glunn, Lowell D. *Let's Play Games in Metrics* Skokie, Ill.: National Textbook, 1974. $6.25.

Games and activities for teaching the metric system.

Henry, Boyd. *Teaching the Metric System* Chicago: Weber Costello, 1973. $1.50.

Illustrated guide for teachers; suggested hands-on activities and materials.

Higgins, Jon L., ed. *A Metric Handbook for Teachers* Reston, Va.: National Council of Teachers of Mathematics, 1974. $2.40.

Compilation of articles giving practical suggestions to teachers.

Izzo, John. *Metrication in American Style* Bloomington, Ind.: Phi Delta Kappa Educational Foundation, 1974. $0.50.

Brief history, overview of the system, recommended sources, appropriate cautions.

Miller, Mary, and Richardson, Toni. *More Metric Cookbook* Hayward, Calif.: Activity Resources, 1974. $3.00.

Compendium of cooking in metric recipes for elementary pupils.

Richardson, Toni. *Making Metric Measures* Hayward, Calif.: Activity Resources, 1974. $5.00.

Games and activities involving physical movements.

Robinson, Berol D. *Education (An Interim Report of the U. S. Metric Study)* National Bureau of Standards, Special Publication 345-7, 1971. $1.75 (SD Catalog No. C13.10:345-6).

Report to the Congress from the Department of Commerce, contains status and recommendations for education.

Smart, James R. *Metric Math: The Modernized Metric System (SI)* Monterey, Calif.: Brooks Cole, 1974. $3.50.

Summary of SI, with activities, technical details for high school mathematics.

Trueblood, Cecil R. *Metric Measurement Activities and Bulletin Boards* Dansville, N.Y.: Instructor, 1973. $1.50.

Lesson and bulletin board ideas on length, area, weight, and volume, spells deka with "c" and uses dk symbol.

Non-Print

At Home With Metric Measurement Multimedia kit. New York: Butterick. $7.5.

Kit containing devices for measuring weight, temperature, capacity, and length, charts for metric pattern measurements, a cassette/filmstrip and a teachers manual.

Bielefeld, Carole. *SI-A Metric Workbook for Teachers of Consumer and Homemaking Education* Santa Ana, Calif.: Orange County Dept. of Education, 1974. $1.50.

Transparency masters and classroom activities geared to daily measurement uses in the American home.

Measure and Observe Activity Cards Chicago, Ill.: Educational Teaching Aids, 1974. Set I, Length and Area, $3.95, Set II, Weight, $3.95, Set III, Liquid volume, $3.95. Set of 3, $11.50.

Forty-eight laminated cards which suggest activities for measuring with metric tools.

Measurement and Metric System Science Packet. Kit Washington, D.C.: National Science Teachers Association, 1973. $3.00.

Multimedia kit includes centimeter rulers, booklets, graph paper, decimeter box, charts, conversion tables, and resource listings.

Measurement Skills Multimedia kit-Encyclopaedia Britannica, 1972. $60.00.

Lessons including booklets, task cards, and tools for measuring picture models.

A Metric America 6 sound filmstrips, color. Hollywood, Calif AIMS, 1973 w/discs, $78, w/cassettes, $90

History, length, area, volume, weight, and temperature, with much detail of instruction, errs in placing periods after metric symbols, teacher's guide

Metric Length and Area Multimedia kit Chicago, Ill. Weber Costello, 1974 $14 95

Cassette program including tape measures, area grids, height measures, spirit masters, posters, and teacher's manual

Metrics for Elementary Series 3-16mm, color Los Angeles Calif Oxford Films $140

Brief presentations of length and distance, volume and capacity, weight and mass

FOR THE PARENTS' SHELF

Print

Barbrow, Louis E *What About Metric?* National Bureau of Standards, Consumer Information Series 7 1973 $1 10 (SD Catalog No 0303-01191)

Colorful pamphlet of metric information with pictures Useful for display.

Going Metric Greenfield, Mass Channing L Bete, 1974 $0 25

Pamphlet describes the Modernized Metric System (SI) and why it is coming to the United States

The Modernized Metric System Explained Neenah Wis J J Keller, 1974 $0 49

A comprehensive leaflet of metric information with some history, an overview, and conversion factors

Moving Toward Metric New York J C Penney, 1974 Free on request to Educational Relations Dept

Packet of material on metric consumerism Scripts for radio-TV included

The Swing to Metric Detroit General Motors Corp, 1973 Request pamphlet from Personnel Communications Department

Metric system background and growth, with applications to General Motors

Non-Print

The Metric Song Filmstrip and cassette, color J C Penney Company, 1974 Available on loan through J C Penney stores, Educational Relations Dept

Entertaining explanation of why we are going metric Musical listings of metric units, uses, and relationships

NBS Metric Kit National Bureau of Standards, Special Publication 410 1974 $2 00 (SD Catalog No C13 10 410)

A kit containing various NBS publications, ruler conversion card, brief history and references

METS

METRIC EDUCATION TECHNICAL SUPPORT PROGRAM
American Institutes for Research
P O Box 1113, Palo Alto, CA 94302

METS INFORMATION BULLETIN

FREE METRIC MATERIALS AVAILABLE TO TEACHERS

The following metric materials are available at no cost to teachers upon request from the respective suppliers. These materials have been screened by the METS Program for general acceptability, but have not been reviewed in depth. Accordingly, some errors or inconsistencies may have slipped past us. Several items listed below use the "er" spelling, but it was decided to include them in the list because of their overall value. Materials with serious faults, in our judgment, have not been included.

We hope that these materials will continue to be available and that they will be useful to you. As we learn of other free metric materials of value, we will keep you informed.

1. Department of the U.S. Army
   Distribution Division
   Fort Sheridan, Illinois 60037

   "Modernized Metric System" poster (1973)
   Developed by the National Bureau of Standards - suitable for secondary students and adults.

2. Educulture, Inc.
   3184 "J" Airway Avenue
   Costa Mesa, California 92626

   "Think Metric U.S.A. - An Audio-Tutorial Mini Course," 1975
   A simple audio-cassette of selected excerpts and a student instructional manual from their audio-tutorial learning program, "Think Metric U.S.A." - suitable for elementary and secondary students and adults.

3. Federal Reserve Bank of Minneapolis
   Minneapolis, Minnesota 55480

   "The United States and the Metric System,"
   Ninth District Exponent Number 10, 1976
   A large booklet updates the history of metrication through 1975, reviews the pros and cons of metrication, and offers an examination of some of the problems associated with conversion along with ways of relieving those problems - suitable for adult and secondary high school levels. Classroom copies available.

4. Field Enterprises Educational Corporation
   Merchandise Mart Plaza
   Chicago, Illinois 60654

   "Metric System/Weights and Measures:
   Reprint from The World Book Encyclopedia, 1976 sections on the "Metric System" and "Weights and Measures" - 13 pages.
   (Unfortunately, the articles contain many conversion tables.)

5. JC Penney Educational Materials - write your local store

"Insights Into Consumerism: Moving Toward Metric," 1974
Packet includes:
(a) Five pamphlets discussing our changeover to metric activities and duplicating or overhead projector materials
(b) Poster - "The Language of Metric"
(c) Script for radio/TV - "Moving Toward Metric"

(Because the materials were produced in 1974, information on legislation is not up-to-date. Material discusses only liquid volume and assumes that volume is only measured in litres.)

"The Metric Song" - filmstrip available on loan for one week.

6. LaPine Scientific Company
Department 05
6001 South Knox Avenue
Chicago, Illinois 60629

"Plastic metric ruler

"Metric Handbook," a publication which contains activities and exercises for the classroom.
We were not able to review this handbook.)

7. National Bureau of Standards
Metric Information Office
Washington, D. C. 20234

"Some References on Metric Information"
Metric packet includes:
(a) NBS Special Publication 389, "Some References on Metric Information," 1975
(b) "Brief History of Measurement Systems," 1975 - with a chart of the modernized metric system on the back
(c) Poster - "All You Will Need to Know About Metric," 1974
(d) Pocket-sized, plastic metric conversion card
(e) Chart on metric conversion factors, 1976
(f) Plastic centimetre/inch ruler
(g) "Household Weights and Measures," 1975 - includes information on using the metric system in the kitchen
(h) "America Joins a Metric World," 1976 - reprint from Dimensions/NBS

8. Ohaus Scale Corporation
29 Hanover Road
Florham Park, New Jersey 07932

"Recommended Lists of Equipment for Teaching the Metric System of Measurement," 1976
Booklet designed to help you select and use metric tools in grades K-8. Lists of equipment are arranged grade-by-grade for schools of various sizes and budgets.

9. National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

"Free Materials for the Teaching of Mathematics," August 1976
NCTM update and guide to suppliers of math materials.

10. Prentice-Hall Media, Inc.
150 White Plains Road
Tarrytown, New York 10591

"When You Can't Give 'em An Inch - Metrics Made Easy"
Literature about their metric program which contains a centimetre ruler calibrated in 10 cm units - suitable for bulletin board display.

11. Sears, Roebuck and Company
Consumer Information Service
D/703, Sears Tower
Chicago, Illinois 60684

"An Educator's Guide to Teaching Metrication," 1974
This guide was designed to help secondary teachers incorporate the metric system into different subject areas.

Produced under Grant #G007604212 from the U.S. Office of Education, DHEW

METS

METRIC EDUCATION TECHNICAL SUPPORT PROGRAM
American Institutes for Research
P O Box 1113, Palo Alto, CA 94302

METS Information Bulletin

INEXPENSIVE METRIC PUBLICATIONS

The following metric publications are available at a cost of no more than $2.50 from the respective suppliers. These materials have been screened by the METS Program for general acceptability but have not been reviewed in depth; accordingly, some errors or inconsistencies may have slipped past us. A few of the publications use the "er" spelling but are included here because of their overall value. The materials have been organized by primary target audience, for your convenience.

Teachers

1. Coats and Clarks
   Consumer and Educational Affairs Department
   P. O. Box 1966
   Stamford, Connecticut 06902

   "Educator's Guide to Metric for Clothing Construction"
   Leaflet provides teaching ideas for applying metric to clothing construction. (8 pp., $0.25)

2. Instructional Materials Development Center
   2720 South Main Street
   Winston-Salem, North Carolina 27107

   "All Together Now - Teach Metrics" (1976)
   Includes materials developed for inservice workshops for K-8 teachers as part of the Winston-Salem/Forsyth County Metric Education Project, ESEA Title IVC. Activities chosen represent the kind proven most effective in project school classrooms. (55 pp., $2.00)

   "Criterion-referenced Metric Tests, Levels K-8 (Form A)" ($1.00)

3. Metro Cooperative Educational Service Agency (M-CESA)
   Attn: Harriet Harman, Publications Department
   2268 Adams Drive, N.W.
   Atlanta, Georgia 30318

   "Let's Go Metric" (by Brenda Tapp, Mathematics Coordinator, 1977)
   Activities booklet helps teachers familiarize themselves with the metric system of measurement. Activity cards most appropriate for elementary and middle school students. Useful bibliography contains list of books and pamphlets, periodical articles, and sources for metric information. ($2.50)

   "Make It In Metric" (by Brenda Tapp, Mathematics Coordinator, 1977)
   Handbook of ideas for teacher-made metric material and games that can be made with a minimum of expense. (50 pp., $2.50)

4. National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

"Metric Measurement Activity Cards" (published by Michigan Council of Teachers of Mathematics)
Over 100 metric activities along with ideas on how to use the cards and a list of other metric resource materials. ($2.00)

5. Wayne-Westland Community Schools
Project METRIC
646 N. Wayne Road
Westland, Michigan 48185

"Home Economics - Junior High"
Guide for teachers which includes activities to be used in the areas of cooking, sewing, interior decorating, child care, and food and nutrition. ($1.50)

"Industrial Arts - Junior High"
A compilation of ideas in the areas of drafting, metalworking, and woodworking. ($2.00)

"Olympmetrics"
Booklet describes many track and field events using the metric system of measurement. Based on the experience of the Wayne-Westland Community School District, the guide suggests a format for conducting a district-wide Metric Field Day competition. (40 pp, $1.50)

"Parent Workship Guide"
A guide to assist parents, teachers, and administrators in conducting a parent workshop. Includes suggestions for metric work stations, equipment, bulletin boards, and handouts. ($2.50)

General Public

1. American National Metric Council (ANMC)
1625 Massachusetts Avenue, N.W.
Washington, D. C. 20036

"The Metric System Day to Day"
Introduction to the metric system for employees, clients, and their families. Space on the front cover allows organization to print their own name and logo. (Imprinting information available from ANMC upon request.) Free sample copy available—send a 13¢ stamp and a mailing label. Multiple copies available at the following rates:

	Subscriber	Non-Subscriber	
2-99 copies	25¢	30¢	
100-999 copies	15¢	20¢	
1000-9999 copies	10¢	15¢	
5000-or more	8¢	10¢	(15 pp.)

(Also available from ANMC)

"Metrication and the Consumer: Avoiding Deception in the Marketplace" Report by ANMC Consumer Liaison Committee, including two case studies of conversion in the U.S., suggestions for consumer education programs, a section on metrication in other countries, and a checklist of recommendations to all groups involved in planning for and implementing metrication. Single copies available free of charge--send a 13c stamp and a mailing label. Additional copies available at quantity rates:

less than 10	$0.40
10-49	$0.35
50-99	$0.30
100-499	$0.25

2. Barron's Educational Series, Inc.
113 Crossways Park Drive
Woodbury, New York 11797

"The Metric Book...of Amusing Things To Do" (by Elisabeth Hallamore) An unusual activity, puzzle, and game book for people learning the metric system. (96 pp, $1.95)

3. Creative Productions, Inc.
P. O. Box 27433
St. Louis, Missouri 63141

"The Metrics Are Coming"
Nontechnical booklet intended as a learning (and reference) vehicle for consumers. Booklet was reviewed for technical accuracy of metric use by the U.S. Department of Commerce/National Bureau of Standards. Copies available at the following rates:

up to 500 copies	$0.55
500-999 copies	$0.50
1,000-1,499 copies	$0.45
1,500-1,999 copies	$0.40

4. Educational Pioneers Inc
418 Poole Road
Westminster, Maryland 21157

"Meters" (Book 1). "Liters (Book 2); "Grams" (Book 3)
Three pocketsized booklets directed primarily to parents. Each booklet contains a self-test at the end. Package retails for $1.49, but can be purchased in bulk quantities from the publishers at $0.70 per package

5. Instructional Materials Development Center
2720 South Main Street
Winston-Salem, North Carolina 27107

"A Parents' Guide to Homework"
Booklet for parents of children introduced to metrics in school. Introduces metric terms and provides instructions on making a few metric measuring tools. (15 pp., $0.50)

Business and Professional

1. Burgundy Press
P. O. Box 313
Southampton, Pennsylvania 18966

"Guidelines for Industrial Metrication" (by Prof. Harold W. Byerly, Pennsylvania State University)
Outgrowth of material prepared for presentation at a series of Matric Workshops for Industry. Booklet describes the primary factors involved in establishing and implementing a metric conversion program in industrial companies. (29 pp., $2.00)

2. International Informational Services
P. O. Box 292
Gorham, Maine 04038

"Medicine and Metrication" (by Howard Faulkner, University of Maine)
This publication was prepared to assist physicians' offices, hospitals, clinics, laboratories, and medical educational programs in the adoption of SI. Booklet gives common SI units that have application in medicine and related sciences, temperature guidelines, SI style practices, a discussion of SI in clinical chemistry, and common lab test references. Copies available at the following rates:

less than 10	$1.75
10-49	$1.55
50-99	$1.32
100-499	$1.15

(36 pp.)

"Metric Style SI Manual - For Written and Computer Usage" (edited by Howard Faulkner, University of Maine)
Resource for all writing applications of SI measurement units, prefixes, and symbols, including style rules for data processing applications among processing systems having a limited alphabet or symbols and a chart showing measurement units with SI and computer symbols. Copies available at the following rates:

less than 10	$1.25
10-49	$1.00
50-99	$0.99
100-499	$0.89

3. 3M Company, Visual Products Division
   3M Center, Bldg. 220-10W
   St. Paul, Minnesota 55101

   "Sequence of Metrication Tasks"
   Wall chart which outlines sequence of metric conversion tasks for corporations. The phases of investigation, planning, and implementation are applied to the departments of management, purchasing, engineering/design, manufacturing, marketing and advertising, and word/order processing. ($2.50)

4. U. S. Metric Association (USMA)
   Sugarloaf Star Route
   Boulder, Colorado 80302

   "Metric Handbook for Hospitals" (revised Second Edition)
   A guide for using SI metric units in hospital practice along with recommendations for undertaking a metric implementation program. Copies are available at the following rates:

single copy	$1.00	(14 pp.)
2-9 copies	$0.60	
10-99 copies	$0.45	
100-or more	$0.40	

   "Metric Units of Measure and Style Guide" (revised Eleventh Edition)
   An editorial guide to correct SI metric practice. Copies are available at the following rates:

single copy	$1.00
2-9 copies	$0.60
10-99 copies	$0.40
100-or more	$0.35

Produced under Grant #G007702036 from the U.S. Office of Education, DHEW